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Managing supply chain uncertainty arising from geopolitical disruptions: Evidence from the pharmaceutical industry and Brexit

Abstract:

Purpose: This paper examines how firms of different sizes formulate and implement strategies to achieve fit with an external environment disrupted by a geopolitical event. The context of the study is the pharmaceutical industry and how it managed the supply chain uncertainty created by the United Kingdom's decision to leave the European Union, or Brexit.

Design/methodology/approach: Data were collected longitudinally from the pro-Brexit vote on 23rd June 2016, until the UK's departure from the EU on 31st January 2020. Twenty-seven interviews were conducted in the pharmaceutical sector, including nineteen interviews with senior managers at eight case companies and eight interviews with experts working for trade associations and standards institutes. The interview findings were triangulated with Brexit policy and strategy documentation.

Findings: When formulating strategy, multi-national enterprises (MNEs) used worst case assumptions, while large firms, and small and medium sized enterprises (SMEs) gathered knowledge as part of a 'wait-and-see' strategy, allowing them to reduce perceptions of heightened supply chain uncertainty. Firms then implemented reactive and/or proactive strategies to mitigate supply chain risks.

Originality/Value: The study elaborates on strategic contingency theory by identifying two important conditions for achieving strategic fit: first, companies deploy intangible resources, such as management time, to gather information and reduce perceptions of heightened supply chain uncertainty. Second, companies deploy tangible resources (supply chain redundancies, new supply chain assets) to lessen the negative outcomes of supply chain risks. Managers are provided with an empirical framework for mitigating supply chain uncertainty and risk originating from geopolitical disruptions.

Key Words: Supply chain risk management, supply chain uncertainty, contingency theory, geopolitical risks

1. Introduction

Geopolitical events can significantly disrupt supply chains (Hendry et al., 2019; Simangunsong et al., 2012). Witness the trade dispute between the Chinese and the United States governments in 2019 that prompted companies to rethink sourcing strategies and the location of manufacturing facilities (Financial Times, 2019). Or, the 2019 political protests in Hong Kong that shut down the city centre and disrupted transportation networks (*The Economist*, 2019a). Due to the increasing regularity of disruptive geopolitical events (World Economic Forum, 2020), a firm's competitive priority becomes formulating and implementing strategies that achieve fit between the organisation and an uncertain business environment (Miller, 1992; Miller and Friesen, 1983; Venkatraman, 1989).

Importantly, the need to achieve fit is not confined to the boundaries of the firm. Supply chains regularly criss-cross political borders, exposing buyers and suppliers to significant uncertainty from geopolitical disruptions. Supply chain uncertainty is defined as uncertainties that may occur at any point within a global supply chain network, leading to positive or negative outcomes (Simangunsong et al., 2012 p. 4494; Wagner and Bode, 2008). While many disruptive events are beyond a manager's direct control, negative outcomes can be indirectly mitigated by deploying resources to produce a desired change in the external environment (Luthans and Stewart, 1977; Thompson, 1967). For example, a manager can recruit knowledgeable staff who have an in-depth understanding of changing markets (Burns and Stalker, 1994), or collaborate with suppliers who have detailed knowledge of emerging technologies (Lawson and Potter, 2012).

However, cash, people, and equipment tend to be tied up in on-going projects, making it challenging for managers to deploy resources at short notice when a disruption occurs (George, 2005). It is firms with organisational slack that can deploy resources quickly in response to environmental fluctuations (Sharfman et al., 1988; Thompson, 1967). Resource slack is defined as potentially utilisable resources that can be diverted or redeployed for the achievement of organisational goals (George, 2005 p. 661). Firm size has been directly correlated with the amount of resource slack within the firm (George, 2005 p. 674); this is because larger firms have greater physical and financial capacity to hold excess resources than smaller firms (George, 2005; Sharfman et al., 1988).

The supply chain uncertainty literature has explored how firms redeploy resources and reconfigure supply chain assets to build resilience against supply chain disruptions (Ambulkar et al., 2015; Hendry et al., 2019; de Sá et al., 2019). In addition, the supply chain risk management (SCRM) literature has shed light on how firms deploy tangible resources to mitigate risks related to natural disasters (Elluru et al., 2017; de Sá et al., 2019), terrorist

attacks (Knemeyer et al., 2009), supplier insolvencies (Thun and Hoenig, 2011), and financial crises (Blome and Schoenherr, 2011). Addressed in less detail is how firms formulate and implement strategies to achieve fit with an external business environment disrupted by geopolitical events. Developing such an understanding is important because geopolitical disruptions can impede the flow of information and materials at borders and ports, and lead to increased costs from tariff and non-tariff barriers (Cáceres and Ear, 2012). The purpose of this paper is to answer the following research questions:

- RQ1: How do firms formulate and implement strategies to manage the supply chain uncertainty arising from a geopolitical disruption?
- RQ2: How does firm size affect the formulation and implementation of strategies to achieve fit with an external business environment disrupted by a geopolitical event?

We examine these questions through a strategic contingency theory lens (Dess et al., 1997; Miller, 1992; Miller and Friesen, 1983; Venkatraman, 1989) and by adopting a theory elaboration approach (Ketokivi and Choi, 2014). The study was situationally grounded in the context of pharmaceutical firms managing supply chain uncertainty arising from the political decision made by United Kingdom (UK) voters to leave the European Union (EU), or Brexit. Studying Brexit permits an examination of a significant geopolitical event in real-time, one that affects almost every aspect of the supply chain from the positioning of supply chain assets, material and information flows, to human resource availability and access to suppliers (Hendry et al., 2019). We confine our examination to the pharmaceutical sector to control for industry effects, and because this sector has been profoundly influenced by UK and EU policy decisions related to Brexit. Data are collected longitudinally; from the time of the vote on 23rd June 2016 until the UK's departure from the EU on 31st January 2020. Nineteen interviews were held with senior managers at eight case companies in the pharmaceutical sector and triangulated with eight expert interviews from pharmaceutical trade associations and standards institutes. The interview findings were then triangulated with secondary Brexit policy and strategy documentation.

The remainder of the paper is organised in five sections. In the next section, we use a strategic contingency theory lens to examine supply chain uncertainty and risk. Section 3 provides a justification for the research design, while Section 4 discusses the findings. Section 5 compares the study's findings to the existing literature to arrive at an empirically informed framework consisting of four propositions. The framework sets out how firms formulate strategies to manage supply chain uncertainty and subsequently deploy intangible

and tangible resources to mitigate supply chain risk. The paper concludes by outlining the study's theoretical and managerial contributions and highlighting potential avenues for future research.

2. Theoretical Background and Literature Review

2.1 Strategic Contingency Theory

Uncertainty is defined as “an individual's perceived [in]ability to predict outcomes in the general business environment accurately because of insufficient information or the inability to discriminate between relevant and irrelevant data” (Milliken, 1987, p. 136). This definition suggests that the amount of uncertainty that a firm experiences is influenced by a decision maker's perception as they attempt to organise and evaluate environmental stimuli and make sense of incoming information (Downey and Slocum, 1975). In early writings, organisational theorists explored how firms could achieve fit between organisational structure and the external environmental context to reduce uncertainty and improve corporate performance, in what is now termed ‘structural’ contingency theory (Burns and Stalker, 1994; Lawrence and Lorsch, 1967; Thompson, 1967).

Strategy theorists countered that while structure is one device to facilitate the handling of information about the external business environment, the strategy making process is another (Miller and Friesen, 1983). They argued that different levels of environmental variation require different degrees of strategy formulation to match organisational resources with opportunities and threats in the external business environment (Andrews, 1987; Hofer, 1977; Venkatraman, 1989). This notion of ‘strategic’ contingency theory proposed that the process of achieving fit begins with aligning the company to its marketplace; it is this process of alignment that defines the company's strategy (Dess et al., 1997; Miles and Snow, 1994; Miller and Friesen, 1983; Venkatraman, 1989). The desire to change a firm's strategic direction is motivated by alterations in external contingences linked to the general and local environment, as well as internal contingences related to input resources, business competencies, and the firm's current strategy (Miller and Friesen, 1983; Zajac et al., 2000).

Theoretical and practical contributions to contingency theory are achieved by first identifying important contingency variables that distinguish between contexts, then by grouping different contexts based on these contingency variables, and finally by determining the most effective organisational response to each major group (Sousa and Voss, 2008). Contingency variables can be grouped into four broad categories; national context and culture, firm size, strategic context, and other internal organisational context variables (Ketokivi and Schroeder, 2004; Sousa and Voss, 2008). To bound the scope of

this paper and answer the research questions, we focus on firm size and strategic context as our contingency variables. Specifically, we seek to understand the interaction between firm size and strategic context when formulating and implementing strategy to achieve fit with an external environment disrupted by a geopolitical event.

A key premise of strategic contingency theory is that strategic fit is organisationally and temporally unique, rather than common across many organisations in a given context (Zajac et al., 2000). Strategic change that leads to fit with one contingency variable but significantly decreases fit with other contingency variables will not lead to performance benefits for the firm (Zajac et al., 2000). A strategic misfit occurs when an organisation is not able to change, often due to insufficient resources, an unwillingness to change, or even an unawareness of the need to change in the face of environmental shifts (Henderson and Clark, 1990; Leonard-Barton, 1990; Zajac et al., 2000). When a firm has appropriate and sufficient resources, these resources can be bundled and deployed to drive strategic change (Miller, 1992; Zajac et al., 2000).

However, these resources must first be freely available, in the form of organisational slack (Cheng and Kesner, 1997). Slack resources can be tangible or intangible (George, 2005). Tangible resources are measurable; they relate to investments where it is possible to calculate both the input cost and the financial outcomes of the investment (Hadjikhani, 1997). They include fixed assets, such as spare capacity in manufacturing facilities, excess vehicles, and unused space in distribution facilities (Modi and Mishra, 2011), and variable assets, such as surplus raw materials, temporary labour, and excess inventory (Modi and Mishra, 2011). Decisions on where to deploy fixed assets tend to be made at the strategic level of the firm because of the high cost and longer term nature of the decision (Allaoui et al., 2019). Decisions on the deployment of variable assets are made on a short-term, semi-regular basis at the operational level of the firm (Allaoui et al., 2019). Intangible resources, on the other hand, are difficult to quantify. They are relationship specific and are difficult to redeploy to another relationship (Figueira-de-Lemos et al., 2011). Examples of intangible resources include knowledge gathering, searching for information, relationship building, and allocating management time to understand and reduce the uncertainty faced by the organisation (Surroca et al., 2010). Search and knowledge gathering activities have been shown to help firms better anticipate, and even avoid, risks linked to supply chain disruptions (Braunscheidel and Suresh, 2009).

2.2 Supply Chain Risk and Uncertainty

2.2.1 Passive SCRM strategies

Supply chain risk is defined as “the likelihood and impact of unexpected macro, and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities” (Ho et al., 2015, p.5035). SCRM strategies are typically categorised as proactive, reactive, or passive (Grotsch et al., 2013). Passiveness implies doing nothing until the risk event manifests and then reacting chaotically and aimlessly after the event (Grotsch et al., 2013). Passive SCRM strategies receive very limited attention in the supply chain risk literature and are considered the weakest form of counteracting supply chain risk, with outcomes mainly subject to chance (Grotsch et al., 2013).

2.2.2 Reactive SCRM strategies

A review of the SCRM literature highlights ambiguity on the exact nature of reactive strategies. One group of scholars suggest that reactive strategies are characterised by measures taken in advance of the event to reduce its severity (Chopra and Sodhi, 2004; Grotsch et al., 2013; Jüttner et al., 2003; Thun and Hoenig, 2011), while other authors argue that reactivity refers to the post-disruption phase, where companies focus on recovering quickly and returning to a desired state (Ali et al., 2017; Brandon-Jones et al., 2014). There is also dispute surrounding the nature of the response. One group of authors focuses on building redundancies in the form of excess inventory and surplus capacity to reduce the severity of the event (Chopra and Sodhi, 2004; Kwak et al., 2018; Sheffi and Rice, 2005; Thun et al., 2011), while other scholars suggest that reactive strategies include moving production quantities and inventory to different manufacturing facilities to avoid the disruption entirely (Tang and Tomlin, 2008). Still other authors stress that companies should increase capacity in the transportation network (Jüttner et al., 2003; Tang and Musa, 2011), or embed flexibility in the manufacturing and distribution process to enable a quick response (Craighead et al., 2007; Jüttner et al., 2003; Sánchez and Pérez, 2005; Stevenson and Spring, 2007; Tang and Tomlin, 2008).

A common theme running throughout this discourse is that a reactive SCRM strategy includes the deployment of fixed and variable assets to reduce the severity of the disruption. What is disputed is when a company’s intervention should occur (before or after the event) and the organisational level at which the decision to intervene is made. To provide clarity, we offer the following definition of reactive SCRM strategies:

Tactical and operational decisions that lead to tangible investments in variable assets aimed at reducing the severity of a risk event.

This definition stresses that reactive strategies are applied before the risk event and encompass tactical and/or operational decisions to reduce the severity, but not the probability, of a disruptive event. As investments are in variable, and not fixed, assets, the decision is typically made at the operational or mid-management level of the firm, and not by senior managers at the strategic level (Allaoui et al., 2019).

2.2.3 Proactive SCRM strategies

Proactive SCRM strategies tend to refer to the commitment of fixed assets into new facilities, supplier contracts, or risk monitoring systems (Elluru et al., 2017; Knemeyer et al., 2009). For example, proactive strategies may include multi-sourcing/dual sourcing strategies (Craighead et al., 2007; Jüttner et al., 2003; Norrman and Jansson, 2004), and sharing and transferring risk to supply chain partners (Tang and Tomlin, 2008). Proactive strategies can also include extending existing storage and distribution facilities or moving supply chain facilities away from high risk locations (Knemeyer et al., 2009). Proactiveness may also include hedging against financial risks (Blome and Schoenherr, 2011; Hendricks and Singhal, 2003, 2005), investing in enterprise risk management systems (Grotsch et al., 2013), or planning software and systems (Huang et al., 2009; Knemeyer et al., 2009).

Grotsch et al. (2013) suggests that proactive strategies are expressed in two dimensions: 1) actions taken before the event to reduce the probability that the risk occurs; and 2) actions taken in advance to reduce the impact of the risk event when it occurs. However, this definition is equivocal because attempting to reduce the severity of an event overlaps with reactive strategies. To provide clarity, we define proactive SCRM strategies as:

Strategic decisions that lead to tangible investments in fixed assets that change the supply chain network architecture and reduce or eliminate the probability of a risk event.

Our definition stresses that proactive strategies are strategic decisions made to deploy fixed assets with the aim of reducing the probability, but not the severity, of a disruptive event.

2.2.4 Supply Chain Uncertainty

The supply chain uncertainty literature tends to focus on the reconfiguration of tangible resources, such as inventory and supply chain assets, to build resilience against negative outcomes of supply chain disruptions (Ambulkar et al., 2015; Brandon-Jones et al., 2014; de Sá et al., 2019). For example, Flynn et al. (2016) find that the negative outcomes of supply chain uncertainty can be managed through integrating supply chain processes and organisational structure to achieve alignment with the external environment. Other authors stress the importance of intangible resources in minimising the negative effects of supply chain disruptions, including lobbying governments and identifying new business opportunities (Hendry et al., 2019), or building internal social capital to build resilience through a firm's human resources (Polyviou et al., 2019).

The lines between SCRM and supply chain uncertainty often become blurred as both literatures concentrate on how firms deploy resources to avoid or mitigate negative outcomes of supply chain disruptions (see Ho et al., 2015; Thun et al., 2011; Trkman and McCormack, 2009). However, risk and uncertainty are distinct concepts. Risk describes decision situations in which probabilities are available to guide choice, while uncertainty describes decision situations in which information is too imprecise to be summarised by probabilities (Knight, 1921). Risk is therefore a consequence of uncertainty and not a substitute for it (March and Shapira, 1987). By extension, supply chain risks arise due to perceived uncertainty in the external business environment. To gain a better understanding of how perceptions of heightened uncertainty can be reduced, we now turn to the field of International Business.

2.2.5 Wait-and-see strategies

International Business scholars divide uncertainty into pure and contingent uncertainty (Figueira-de-Lemos et al., 2011). While pure uncertainty refers to future events that are impossible to know and plan for, contingent uncertainty implies that the more an individual learns, the more that individual can do to develop different contingency plans (Jones, 2013). When contingent uncertainty is high, managers are often reluctant to make tangible resource commitments because there is too much at stake and such decisions are difficult and costly to reverse (Figueira-de-Lemos and Hadjikhani, 2014). Instead, managers are more likely to make intangible resource commitments to gain knowledge about the situation – termed a 'wait-and-see' strategy (Hadjikhani, 1997; Sull, 2005).

A wait-and-see strategy is defined as “a measured decision to make intangible resource commitments to gather knowledge about the disruptive event and reduce contingent uncertainty” (Clarke and Liesch, 2017, p. 924). Managers operating in turbulent markets cannot create the timing of the rare golden opportunity, nor can they predict with any certainty the exact nature of a disruptive event; they therefore have to wait-and-see for such situations to become apparent (Sull, 2005). With a wait-and-see strategy, the company aligns its strategic focus to the particular market context, and reacts according to the present situation as-is, be it an opportunity or threat, without making tangible resource commitments (Clarke and Liesch, 2017; Sull, 2005). The company commits intangible resources to gather new knowledge by forming new, or strengthening existing, relationships with other actors in the supply chain (Hadjikhani, 1997; Sull, 2005).

The concept of wait-and-see goes largely undiscussed by SCRM and supply chain uncertainty scholars, even though it is distinct from passive, reactive, and proactive strategies. A wait-and-see strategy is not proactive because tangible resource commitments are not made in advance to reduce the probability of the disruptive event occurring. Nor is it reactive, as tangible resources are not committed to reduce the severity of the event. Moreover, a wait-and-see strategy is not passive, because the firm does not stand idly by as the disruptive event happens and react haphazardly after the event. Instead, a wait-and-see strategy is the deliberate commitment of intangible resources to acquire knowledge about the disruptive event to reduce contingent uncertainty (Clarke and Liesch, 2017). Table 1 provides a comparison of the four strategies for managing supply chain uncertainty and risk based on the intent, level of decision-making, timeframe, and resource commitment.

Passive Strategy	
Definition	A “do-nothing” approach where business carries on as usual until after the event has materialised (Grotsch et al., 2013).
Decision Level	No decisions until after the event.
Resource Commitments	No resource commitments are made until after the event. The company carries on business as usual (Grotsch et al., 2013).
Strategy elements	<ul style="list-style-type: none"> Not taking any deliberate action in advance to address the disruptive event (Grotsch et al., 2013). Taking action only after the event to minimise the disruption to the supply chain (Grotsch et al., 2013). Business-as-usual (Grotsch et al., 2013).
Reactive Strategy	
Definition	Tactical and operational decisions that lead to tangible investments in variable assets aimed at reducing the severity of a risk event.
Decision Level	Operational and tactical.
Resource Commitments	<ul style="list-style-type: none"> Investing in variable assets in a quantifiable way (tangible resource commitment into variable assets).
Strategy elements	<ul style="list-style-type: none"> Building redundancies in the form of excess inventory and surplus capacity to reduce the severity of the event (Chopra and Sodhi, 2004; Kwak et al., 2018; Sheffi and Rice, 2005; Thun et al., 2011). Moving production quantities and inventory to different manufacturing facilities to avoid the disruption entirely (Tang and Tomlin, 2008). Increasing capacity in the transportation network through additional modes of transportation or transportation providers (Jüttner et al., 2003; Tang and Musa, 2011). Embedding flexibility in the manufacturing and distribution process to enable a quick response to supply chain disruptions (Craighead et al., 2007; Jüttner et al., 2003; Sánchez and Pérez, 2005; Stevenson and Spring, 2007; Tang and Tomlin, 2008).
Proactive Strategy	
Definition	Strategic decisions that lead to tangible investments in fixed assets that change the supply chain network to reduce or eliminate the probability of a risk event.
Decision Level	Strategic
Resource Commitments	Investing in fixed assets in a quantifiable way (tangible resource commitment into fixed assets).
Strategy elements	<ul style="list-style-type: none"> Making new supplier contracts: multi-sourcing/dual sourcing (Craighead et al., 2007; Jüttner et al., 2003; Norrman and Jansson, 2004). Extending existing storage and distribution facilities (Knemeyer et al., 2009). Moving supply chain facilities away from high risk locations (Knemeyer et al., 2009). Investing in enterprise risk management systems (Grotsch et al., 2013). Hedging against financial risks (Blome and Schoenherr, 2011; Hendricks and Singhal, 2003, 2005). Using tools and software to identify risk (Huang et al., 2009; Knemeyer et al., 2009).
Wait-and-See Strategy	
Definition	A measured decision to make intangible resource commitments to acquire knowledge about the disruptive event, through building relationships with stakeholders, and reduce contingent uncertainty (Clarke and Liesch, 2017).
Decision Level	Data gathering for strategic, tactical, and operational decisions.
Resource Commitments	Intangible resource commitments.
Strategy elements	<ul style="list-style-type: none"> Investing in relationships with suppliers, government bodies, trade associations, and policymakers to gather information about the disruptive event (Figueira-de-Lemos and Hadjikhani, 2014). Knowledge gathering activities (Clarke and Liesch, 2017). Making intangible/unquantifiable resource commitments.

Table 1: A comparison of Supply Chain Risk and Uncertainty Strategies

3. Research Design

Our research strategy is based on a theory elaboration approach, which focuses on the contextualised logic of a general theory (Ketokivi and Choi, 2014). To elaborate on strategic contingency theory, we worked abductively (Niiniluoto, 1999), continuously moving between the empirical data and theory. While guided by *a priori* theoretical considerations, we remained open to unanticipated findings and the possibility that the general theory required reformulation (Merton, 1968). The study was situationally grounded in the context of pharmaceutical firms managing supply chain uncertainty arising from the pro-Brexit vote.

The research design is based on a multiple case study of eight pharmaceutical companies; this allowed the phenomena of supply chain uncertainty to be studied within the context of a real-life geopolitical event: Brexit. This study spans the Brexit process from the day of the pro-Brexit vote on 23rd June 2016 to the departure of the UK from the EU on 31st January 2020. Case selection used theoretical replication logic, in which cases are expected to provide different findings for explainable reasons (Yin, 2014) based on company size. We selected three multinational enterprises (MNEs), three large firms, and two SME companies from the domain of pharmaceutical companies in the UK. Throughout the study, we attempted to reconcile the idiosyncrasies of the data with strategic contingency theory and, when unanticipated findings were identified, we elaborated theory (Ketokivi and Choi, 2014). Next, the context of the study is introduced.

3.1 Context of Study: Brexit and the Pharmaceutical Industry

On 23rd June 2016, the people of the United Kingdom voted on whether to remain in, or to leave, the European Union (EU). The vote was 51.9% in favour of the UK departing the EU, with the outcome creating a profound sense of surprise and shock on both sides of the debate (Wincott, 2017). In the aftermath of the vote, Britain's Prime Minister, David Cameron, resigned and the Financial Times Stock Exchange (FTSE) 250 index fell by 13% (Rodionova, 2016). David Davis, the then Secretary of State for Exiting the European Union, described Brexit as the "biggest change for a generation" (Wincott, 2017), while other sources claimed Brexit to be "the most difficult public policy challenge faced by the UK since World War II" (*Washington Post*, 2018).

On 29th March 2017, the new UK Prime Minister, Theresa May, triggered Article 50, giving the UK two years to negotiate an exit deal with the 27 remaining EU member states. By 18th November 2017, over 500 days had passed since the Brexit referendum and fewer than 500 days were left until Britain was due to leave the EU, yet negotiations were still

agonisingly slow (*The Economist*, 2017). At that point, it was still unclear whether the European Council would agree to begin the second phase of talks on transitional arrangements and future trade relations, with frustrated pro-Brexiteers increasingly advocating to walk away from the negotiation table with no deal at all (*The Economist*, 2017). A year later, on 26th November 2018, Theresa May returned from Brussels with a negotiated agreement that spelled out the UK's withdrawal terms. She warned members of the UK parliament that not agreeing to the withdrawal deal would lead to further division and uncertainty across the UK (BBC.co.uk, 2018). On 16th January 2019, she put the deal to the UK House of Commons in a meaningful vote that was rejected by 432 to 202 votes (www.parliament.uk, 2019). During February and the early weeks of March 2019, Theresa May renegotiated the withdrawal agreement with her EU counterparts to secure more favourable terms. She put the withdrawal agreement to the UK parliament in a second meaningful vote on 12th March 2019; it was again rejected, by 391 to 242 votes (*The Economist*, 2019b). Two days later, a vote by the parliament moved the date of departure from 31st March 2019 to 30th June 2019. This date was then subsequently extended by Brussels until 31st October 2019, prolonging the uncertainty for UK businesses (*The Guardian*, 2019).

After being elected as the leader of the Conservative Party, Boris Johnson pledged to “get Brexit done” by 31st October. However, Parliament's support was not forthcoming and instead he secured yet another extension to 31st January 2020. The Conservative Party called for, and won with a majority, the General Election on 12th December 2019, ensuring that the UK would depart the EU on 31st January 2020. At the time of writing this paper the government planned to complete trade negotiations during 2020, such that a trade agreement would be in place by 31st December 2020.

The UK's pharmaceutical industry is selected as the industry of study because it provides an ideal setting to explore how supply chains are affected by Brexit uncertainty. More than 2,600 pharmaceutical products have some stage of manufacture in Britain, and 45 million patient packs are supplied from the UK to other European countries each month, with another 37 million packs flowing in the opposite direction (Reuters.com, 2018). When the European Medicines Agency (EMA) relocated its headquarters from London to Amsterdam in 2018, Britain became a so-called ‘third country’ for the purposes of medicines regulation, creating further uncertainty about the future process for drug approvals for UK pharmaceutical firms (Reuters.com, 2018). Strategically sensitive industries, including pharmaceuticals, were advised by UK regulators to implement no-deal plans by the end of 2017 (*The Economist*, 2017). Pharmaceutical companies were told “to

ensure they have a minimum of six-weeks' additional supply in the UK, over and above their business as usual operation buffer, by 29 March 2019" (Reuters.com, 2018). These new regulatory requirements and procedural changes impeded access to European markets and created high degrees of uncertainty for UK pharmaceutical firms (*The Economist*, 2019b).

3.2 Data Collection

Qualitative data were gathered using the key informant technique (Marshall, 1996; Tremblay, 1957). As per Carter and Jennings (2002), we identified key informants by selecting senior level managers with at least three years' experience and with a detailed understanding of the phenomenon under investigation. Interview data were collected longitudinally over a three-year period, from May 2017 to 31st January 2020, using 27 interviews with 19 key informants. Six of the key informants were industry experts (coded as EXP), from four organisations) and the remaining thirteen worked in companies: multinational enterprises (coded as MNE, from three companies), large pharmaceutical companies (coded as LRG, from three companies), or small and medium sized enterprises (coded as SME, from two companies). Eight of the key informants were interviewed twice throughout the analysis period to capture the longitudinal effects of Brexit uncertainty as it unfolded. To protect the anonymity of the companies, we use codes such as MNE1, LRG2, or EXP3 to distinguish information collected from different organisations. We use codes such as MNE2a and MNE2b to distinguish key informants from the same organisation. Figure 1 provides an overview of when the interviews were conducted.

	2017		2018		2019		2020	
Organisation	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Total
MNE1	1			1				2
MNE2	2			1				3
MNE3		1		1	1			3
LRG1				2			2	4
LRG2					2			2
LRG3					1			1
SME1		1		1				2
SME2		1		1				2
EXP1	1							1
EXP2		1		1				2
EXP3		1		1				2
EXP4		3						3

Figure 1: Timing of longitudinal interviews with company senior managers and experts

Each interview lasted between thirty minutes and one hour and was transcribed verbatim for coding and analysis. The longitudinal analysis was split into three time periods, in conjunction with the key events of the Brexit phenomenon. We consider the long-term period to be from 23rd June 2016 (the date of vote) to 18th November 2017 (the halfway point between the vote and the date the UK was initially meant to leave the EU: 29th March 2019). The medium-term period is from 19th November 2017 to 29th November 2018, the day Theresa May returned with the withdrawal deal from Brussels. The short-term period is from 30th November 2018 to 31st January 2020, the date that Britain officially left the EU.

As per Sharfman et al. (1988), we used firm size as a proxy for resource slack. Information on firm size, including number of employees and annual revenue, was gathered from Marketline (2018) and FAME (2019) databases for the 2018-2019 fiscal year. The firm size categorisation was determined by the Organisation for Economic Cooperation and Development (OECD, 2019) definitions; these categorise SMEs as having between 1-500 employees and Large Organisations (LRG) as having 500+ employees. A Multi-National Enterprise (MNE) categorisation was added for organisations with 50,000+ employees and revenues exceeding \$20+ billion, based on data from Statista (2019). As many of the large and MNE organisations are listed on US stock exchanges, we used the OECD US definition of firm size (OECD, 2019) (see Table 2).

No	Org.	Category	Informant role	Times interviewed	Number of Employees	Annual Revenue
1	MNE1	Big Pharma	MNE1: Head of Global Logistics and Warehousing	2	[50,000 - 100,000]	USD [20, 60] billion
2	MNE2	Big Pharma	MNE2a: Supply Chain Director	2	[50,000 - 100,000]	USD [20, 60] billion
3	MNE2		MNE2b: Marketing Manager	1	[50,000 - 100,000]	USD [20, 60] billion
4	MNE3		MNE3a: Global Operations & Change Director	1	[50,000 - 100,000]	USD [20, 60] billion
5	MNE3	Big Pharma	MNE3b: Quality Assurance Manager	1	[50,000 - 100,000]	USD [20, 60] billion
6	MNE3		MNE3c: Marketing Manager	1	[50,000 - 100,000]	USD [20, 60] billion
7	LRG1	Large	LRG1a: Supply Chain Director	2	[500 - 49,999]	USD [10, 19] billion
8	LRG1		LRG1b: Corporate Vice President Supply Chain	2	[500 - 49,999]	USD [10, 19] billion
9	LRG2		LRG2a: CEO of Supply Chain Operations	1	[500 - 49,999]	Not Available
10	LRG2	Large	LRG2b: Supply Chain Director	1	[500 - 49,999]	Not Available
11	LRG3	Large	LRG3: Director of Supply Chain and Procurement	1	[500 - 49,999]	USD [75, 100] million
12	SME1	SME	SME1: Operations Director	2	[100 - 499]	USD [50, 74] million
13	SME2	SME	SME2: CEO	2	[100 - 499]	USD [3, 10] million
14	EXP1	Trade & Policy Observatory	EXP1: Professor of Economics	1		
15	EXP2	Industry Consultancy	EXP2: Managing Director	2		
16	EXP3	Standards and Regulatory Body	EXP3: Head of Pharmaceutical Standards	2		
17	EXP4	Pharmaceutical Trade Association	EXP4a: Head of Manufacturing Technology	1		
18	EXP4		EXP4b: Head of Pharmaceutical Policy	1		
19	EXP4		EXP4c: Quality and Assurance Manager	1		

Table 2: Case study companies with firm size categorisation and key informant

Interview findings were triangulated with findings from eight pharmaceutical industry expert interviews (see Table 2), and with secondary documentary evidence gathered from annual reports, Brexit strategy documentation, policy documentation from trade association websites and UK government websites (UK Industrial Strategy, 2019; www.parliament.uk, 2019), and news websites/databases including Factiva, Bloomberg, Financial Times/FT.com, the *Economist*, and the *Guardian*. The respondent and method triangulation were undertaken to improve construct validity (Yin, 2014).

3.3 Data Analysis

The research team used thematic analysis techniques (Braun and Clarke, 2006) and followed the process outlined by Miles and Huberman (1994) for analysing qualitative interview data. A member of the research team performed first-level coding to summarise and describe the data. The same researcher then performed pattern matching techniques (Miles and Huberman, 1994; Yin, 2014) to group similar codes together and attached these codes to the higher order themes (strategies) previously defined from the literature. The coding process was then repeated by two other members of the research team to enhance reliability (Armstrong et al., 1997). The coding scheme was compared between the three members of the team and changed in an iterative fashion until consensus was reached on the key themes to emerge from the data (Armstrong et al., 1997). The re-coding of the data resulted in close agreement on the primary themes and helped to strengthen the rigour of the qualitative data analysis process (Armstrong et al., 1997). The coding identifiers are shown in the Appendix as they closely follow the literature review summarised in Table 1. They were used to identify passages of text that could be linked to the strategies of passive, wait-and-see, reactive, and proactive. When passages of text were identified that did not fit the coding identifiers, we created new themes, allowing us to elaborate on strategic contingency theory. Finally, the findings were formalised and systemised into propositions that explain how companies achieve strategic fit and reduce perceived supply chain uncertainty. We employed both forward and backward extrapolation to identify strategies of the companies in the long, medium, and short term, based on their responses to questions where they specified what had been done in the past and plans for the future to manage the uncertainty arising from Brexit.

4. Findings

The companies in our study followed a variety of strategies to achieve strategic fit. Table 3 shows the coding identifiers used to determine the strategy that firms' followed.

Strategy	Code and Short-Meaning	Definition from the paper
Passive	Pas-1: No action	Not taking any deliberate action in advance to address the disruptive event (Grotsch et al., 2013).
	Pas-2: Action after	Taking action only after the event to minimise the disruption to the supply chain (Grotsch et al., 2013).
	Pas-3: Business-as-usual	Continuing to operate business-as-usual (Grotsch et al., 2013).
	Pas-Other	Use this code only if text does not fit above definitions.
Wait-and-See	Wai-1: Relationships with Suppliers	Investing in relationships with suppliers to gather information about the event (Clarke and Liesch, 2017).
	Wai-2: Relationships with Government	Investing in relationships with government bodies and policy-makers to gather information about the disruptive event (Figueira-de-Lemos and Hadjikhani, 2014).
	Wai-3: Relationships with Trade Associations	Investing in relationships with trade associations to gather information about the disruptive event (Figueira-de-Lemos and Hadjikhani, 2014).
	Wai-4: Intangible commitment	Making intangible/unquantifiable resource commitments.
	Wai-Other	Use this code only if it is absolutely necessary.
Reactive	Rea-1: Safety stock	Building safety inventory (Chopra and Sodhi, 2004; Knemeyer et al., 2009; Sheffi and Rice, 2005).
	Rea-2: Production	Moving production quantities to different manufacturing facilities (Tang and Tomlin, 2008).
	Rea-3: Inventory routing	Shifting inventory to different distribution and warehousing facilities (Tang and Tomlin, 2008).
	Rea-4: Transport network capacity	Increasing capacity in transportation network through additional modes of transportation or transportation providers (Jüttner et al., 2003; Tang and Musa, 2011).
	Rea-5: Variable assets	Investing in variable assets in a quantifiable way (tangible resource commitment into variable resources).
	Rea-6: Operational and tactical	Taking operational and tactical decisions in response to the event.
	Rea-Other	Use this code only if text does not fit above definitions.
Proactive	Pro-1: Risk sharing	Sharing and transferring risk to supply chain partners (Tang and Tomlin, 2008).
	Pro-2: Multi-sourcing	Making new supplier contracts: multi-sourcing/dual sourcing (Craighead et al., 2007; Jüttner et al., 2003; Norrman and Jansson, 2004).
	Pro-3: Expanding physical network	Extending existing storage and distribution facilities (Knemeyer et al., 2009).
	Pro-4: Relocating fixed assets	Moving supply chain facilities away from high risk locations (Knemeyer et al., 2009).
	Pro-5: Enterprise Risk	Investing in enterprise risk management and systems (Grotsch et al., 2013).
	Pro-6: Financial Risks	Hedging against financial risks (Blome and Schoenherr, 2011; Hendricks and Singhal, 2003, 2005).
	Pro-7: Risk Tools and Software	Using tools and software to identify risk (Huang et al., 2009; Knemeyer et al., 2009).
	Pro-8: Fixed Assets	Investing in fixed assets in a quantifiable way (tangible resource commitment into fixed assets).
	Pro-9: Strategic Decisions	Taking strategic decisions.
	Pro-Other	Use this code only if text does not fit above definitions.

Table 3: Coding identifiers and examples from the literature

Table 4 provides the coding results and the different strategies used by firms over the long, medium and short term. The [B] and the [F] in some of the cells of Table 4 indicate the responses given by the companies on what they have done in the past ([B for backward extrapolation]) and what they plan to do in the future ([F for forward extrapolation]) in addition to what they are doing currently.

Size	Time Period		
	Long Term	Medium Term	Short Term
	23rd June 2016 to 18 th Nov 2017	18 th Nov 2017 to 29 th Nov 2018	30 th Nov 2018 to 31 st Jan 2020
MNE1	<p>WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Talking to supply base about the impacts of doing many customs declarations a year. <i>Wai-4:</i> Assumed World Trade Organization and non-mutual recognition of quality standards.</p> <p>REACTIVE STRATEGY: <i>Rea-2:</i> Production network is flexible where more than one factory makes a given product and UK/EU production can be moved. <i>Rea-4:</i> Ensuring sufficient transport capacity into and from the UK.</p>	<p>REACTIVE STRATEGY: <i>Rea-1:</i> Have high stocks of life-saving products and will build more. Optimising stocks of revenue critical products. <i>Rea-4:</i> Setting up new routings with our transport organisations. <i>Rea-6:</i> Updating systems to produce customs documents for the UK/EU trade.</p> <p>PROACTIVE STRATEGY: <i>Pro-3:</i> Establishing warehouse in the UK to store the product for UK patients, while the EU warehouse will sample products made in the UK and destined for the EU 27. <i>Pro-4:</i> Setting up a Quality Processing hub in Ireland for all of the EU quality release.</p>	<p>REACTIVE STRATEGY [F]: <i>Rea-1:</i> Building an extra several weeks' inventory in the UK, of all non-EU and all EU manufactured products. <i>Rea-4:</i> Setting up new routings with our transport organisations. <i>Rea-6:</i> Updating systems to produce customs documents for the UK/EU trade.</p> <p>PROACTIVE STRATEGY [F]: <i>Pro-3:</i> Establishing warehouse in UK to store the product for UK patients, while the EU warehouse will sample products made in the UK and destined for the EU 27. <i>Pro-4:</i> Setting up a Quality Processing hub in Ireland for all of the EU quality release.</p>
MNE2	<p>WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Talking to suppliers about regulations around importing chemicals into UK and how these might change. <i>Wai-3:</i> Interaction with ABPI as the sole industry communication to the government.</p> <p>REACTIVE STRATEGY: <i>Rea 2:</i> Production network is flexible where more than one factory makes a given product and UK/EU production can be moved.</p>	<p>WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Talking to UK contract manufacturing companies about Quality Release into EU and their ability to build higher stock levels of products. <i>Wai-2:</i> Lobbying government through industry groups and providing data to government on inventory levels and locations.</p> <p>REACTIVE STRATEGY: <i>Rea-1:</i> Stocking an extra 6 weeks of inventory on products as instructed by the government. <i>Rea-3:</i> Suppliers positioning stocks of raw materials. <i>Rea-4:</i> Establishing additional UK inbound port logistics routes. <i>Rea-5:</i> Establishing systems for Quality Release in EU. Packaging suppliers implementing artwork changes due to</p>	<p>REACTIVE STRATEGY [F]: <i>Rea-1:</i> Stocking an extra 6 weeks of inventory on products as instructed by the government and to buffer against customs delays. <i>Rea-3:</i> Suppliers positioning stocks of raw materials. <i>Rea-4:</i> Establishing additional UK inbound port logistics routes. <i>Rea-5:</i> Establishing systems for Quality Release in EU. Packaging suppliers implementing artwork changes due to changes in legal entities and need for separate UK/EU packaging.</p> <p>PROACTIVE STRATEGY [F]: <i>Pro-2:</i> Vaccines produced in UK are being moved to EU. <i>Pro 3:</i> Keeping UK warehouse open (that would otherwise have closed) for additional storage capacity.</p>

Size	Time Period		
	Long Term	Medium Term	Short Term
	23rd June 2016 to 18 th Nov 2017	18 th Nov 2017 to 29 th Nov 2018	30 th Nov 2018 to 31 st Jan 2020
		<p>changes in legal entities and need for separate UK/EU packaging.</p> <p>PROACTIVE STRATEGY: <i>Pro-2:</i> Vaccines produced in UK are being moved to EU. <i>Pro-6:</i> Moved Euro bank accounts to EU.</p>	
MNE3	<p>WAIT-AND-SEE STRATEGY: <i>Wai-3:</i> Corresponding with trade associations. <i>Wai 4:</i> Some financial planning on Brexit implications.</p>	<p>WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Conducting extensive supplier readiness programme with tier 1 and tier 2 suppliers on aspects such as import and export, CE marking. <i>Wai-3:</i> Working with trade associations to give them the information they need to lobby the government. <i>Wai-4:</i> Conducted a what-if style workshop at senior management level to understand the implications of Brexit and questions to ask.</p> <p>REACTIVE STRATEGY: <i>Rea-1:</i> Building extra product inventory, anything between 4 weeks and 6 months. <i>Rea-3:</i> Shifting product inventory closer to market. <i>Rea-4:</i> Establishing additional UK inbound sea-port logistics routes.</p> <p>PROACTIVE STRATEGY: <i>Pro-3:</i> Procuring importation clearance capacity in the UK in terms of a bonded facility. <i>Pro-9:</i> Diverting existing strategic infrastructure programmes and accelerating others.</p>	<p>REACTIVE STRATEGY [F]: <i>Rea-1:</i> Building extra product inventory, between 4 weeks and 6 months. <i>Rea 3:</i> Shifting product inventory closer to market. <i>Rea 4:</i> Establishing additional UK inbound sea-port logistics routes.</p> <p>PROACTIVE STRATEGY [F]: <i>Pro-3:</i> Procuring importation clearance capacity in the UK in terms of a bonded facility. <i>Pro 9:</i> Diverting existing strategic infrastructure programmes and accelerating others.</p>
LRG1	<p>WAIT-AND-SEE STRATEGY [B]:</p>	<p>WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Discussing customs clearance issues with logistics provider.</p>	<p>REACTIVE STRATEGY: <i>Rea-1:</i> Ensuring additional 6 to 8 weeks of product inventory is in the UK 3 months before 29th March, and</p>

Size	Time Period		
	Long Term	Medium Term	Short Term
	23rd June 2016 to 18 th Nov 2017	18 th Nov 2017 to 29 th Nov 2018	30 th Nov 2018 to 31 st Jan 2020
	<p>Wai-1: Discussing customs clearance issues with logistics provider.</p>	<p>Wai-2: Government are requesting an extra 6 weeks product inventory.</p> <p>REACTIVE STRATEGY: Rea-1: Building additional 6 to 8 weeks of product inventory in the UK and buffered some materials exported from the UK to the EU. Rea-2: Ensuring capacity for local as well as global manufacturing of products, for UK for responsive supply. Rea-3: Establishing separate inventories and transportation routes, for Ireland. Rea-4: Finalising air freight routes into the UK to avoid congested ports.</p> <p>PROACTIVE STRATEGY: Pro-2: Possible dual supply of some raw materials from the UK being established in the EU. Pro 6: Always considering the financial currency implications of establishing high stocks in the UK.</p>	<p>then maintaining these stocks and buffering against panic buying. Rea-2: Ensuring capacity for local as well as global manufacturing of products, for UK for responsive supply. Rea-3: Establishing separate inventories and transportation routes, for Ireland. Rea-4: Established air freight routes into the UK to avoid congested ports.</p> <p>PROACTIVE STRATEGY: Pro-2: Seeking dual supply of some raw materials from the UK being established in the EU. Established new supplier for CE marking in Germany. Pro 6: Always considering the financial currency implications of establishing high stocks in the UK.</p>
LRG2	<p>WAIT-AND-SEE STRATEGY [B]: Wai-1: Working with suppliers to ensure they are aware of changes to regulations and possible stocking options. Wai-3: Working closely with MHRA to ensure products will be compliant with regulations. Wai-4: Examining continuity of supply to health providers and the Brexit implications for this.</p>	<p>WAIT-AND-SEE STRATEGY [B]: Wai-1: Working with suppliers to ensure they are aware of changes to regulations and possible stocking options. Wai-3: Working closely with MHRA to ensure products will be compliant with regulations. Wai-4: Examining continuity of supply to health providers and the Brexit implications for this.</p> <p>REACTIVE STRATEGY [B]: Rea-1: Starting to stockpile products.</p> <p>PROACTIVE STRATEGY [B]:</p>	<p>WAIT-AND-SEE STRATEGY: Wai-1: Working with suppliers to ensure they have additional stocks and are aware of changes to regulations. Wai-3: Working closely with MHRA to ensure products will be compliant with regulations. Wai-4: Emergency planning for healthcare providers involving local weekly meetings.</p> <p>REACTIVE STRATEGY: Rea-1: Increased stocks of products with additional replenishment orders in place to maintain this.</p>

Size	Time Period		
	Long Term	Medium Term	Short Term
	23rd June 2016 to 18 th Nov 2017	18 th Nov 2017 to 29 th Nov 2018	30 th Nov 2018 to 31 st Jan 2020
		<i>Pro-3:</i> Establishing extra warehouses to accommodate stockpiling.	<p><i>Rea-4:</i> Established new air freight route from Maastricht to Birmingham; suppliers are prepared to use air freight where necessary.</p> <p><i>Rea-5:</i> Expanding on ability to deal with short-term customer requirements that might need an exceptional response.</p> <p><i>Rea-6:</i> Putting right contingency plans in place to deal with short term challenges.</p> <p>PROACTIVE STRATEGY:</p> <p><i>Pro-3:</i> Established extra warehouses to accommodate stockpiling.</p>
LRG3	No interview evidence	<p>WAIT-AND-SEE STRATEGY [B]:</p> <p><i>Wai-2:</i> Receiving information from the government on preparedness and compliance with EU pharmaceutical regulations.</p> <p><i>Wai-3:</i> Attending meetings held by Pharmaceutical Association of Great Britain, who lobby the government.</p>	<p>WAIT-AND-SEE STRATEGY:</p> <p><i>Wai-2:</i> Receiving information from the government on preparedness and compliance with EU pharmaceutical regulations.</p> <p><i>Wai-3:</i> Attending meetings held by Pharmaceutical Association of Great Britain, who lobby the government.</p> <p><i>Wai-4:</i> Establishing plan to deal with the various Tariff scenarios on products and raw materials imported from the EU.</p> <p>REACTIVE STRATEGY:</p> <p><i>Rea-1:</i> Stockpiled finished products imported from the EU.</p>

Size	Time Period		
	Long Term	Medium Term	Short Term
	23rd June 2016 to 18 th Nov 2017	18 th Nov 2017 to 29 th Nov 2018	30 th Nov 2018 to 31 st Jan 2020
SME1	WAIT-AND-SEE STRATEGY: <i>Wai-3:</i> Providing information and feedback to the ABPI. <i>Wai-4:</i> Developing a report on the worst-case scenario and the operational and financial implications, considering whether product needs to be made earlier.	WAIT-AND-SEE STRATEGY: <i>Wai-1:</i> Suppliers are completing questionnaires on their risk mitigation approaches. Talking to logistics provider about contingencies on product export to EU. <i>Wai-2:</i> Tracking Brexit statements being issued by ABPI. <i>Wai-4:</i> All the departments in the Brexit taskforce have got actions, so dispatch is looking at the extra customs forms. REACTIVE STRATEGY: <i>Rea-1:</i> Building stock of licensed products and aiming to ship them to the EU before the end of March 2019. <i>Rea-5:</i> Appointed a UK QPPV (in addition to an EU one) who looks after pharmacovigilance. Changing manufacturing authorisation licences with our affiliates to make sure that they're EU-owned. Identified a qualified person in the EU for releasing products. PROACTIVE STRATEGY: <i>Pro-3:</i> Establishing new cold stores in Spain and building laboratories.	WAIT-AND-SEE STRATEGY [F]: <i>Wai-1:</i> Chasing suppliers (especially EU) to complete questionnaires on their risk mitigation approaches. Talking to logistics provider about contingencies on product export to EU. <i>Wai-2:</i> Tracking Brexit statements being issued by ABPI. <i>Wai-4:</i> All the departments in the Brexit taskforce have got actions, so dispatch are looking at the extra customs forms. REACTIVE STRATEGY [F]: <i>Rea-1:</i> Building stock of licensed products and aiming to ship them to the EU before the end of March 2019. PROACTIVE STRATEGY [F]: <i>Pro-3:</i> Establishing new cold stores in Spain and building laboratories.
SME2	PASSIVE STRATEGY: <i>Pas-1:</i> No change in strategy, business model or anything else. <i>Pas-3:</i> Don't feel any impact and business carries on as usual.	WAIT-AND-SEE STRATEGY: <i>Wai-3:</i> Following the chemical industry association. <i>Wai-4:</i> Investigating agreements required to export from the UK to the EU after Brexit.	WAIT-AND-SEE STRATEGY [F]: <i>Wai-3:</i> Following the chemical industry association. <i>Wai-4:</i> Investigating agreements required to export from the UK to the EU after Brexit.

Table 4: The coding results and the different strategies used by firms over the long, medium and short term.

4.1 The strategy formulation and implementation process for Multi National Enterprises

Table 4 illustrates that the MNEs in our study formulated strategy by first identifying resource slack and then applying it to the Brexit planning process. An expert informant from a UK pharmaceutical standards agency explained how MNEs had re-allocated tens of millions of pounds towards Brexit contingency planning:

“I was at an industry meeting just last week and spoke to one of the big major multinationals, UK-based. And they've already put aside a contingency spend of £50 million to cover Brexit expenses” - Head of Pharmaceutical Standards (EXP3) 19th October 2017.

As part of the strategy formulation process, MNE1 and MNE3 established a ‘Brexit task force’, comprised of senior managers from Public Relations, Operations, Finance, and Human Resources. The remit of the task force was to develop a high-level strategy that contained contingency plans for managing a no-deal Brexit. The Global Operations and Change Director at MNE3 explains how the strategy formulation process began:

“Immediately after the vote, we got a group of thinkers together who had enough seniority to deal with the possibility and the ambiguity and the lack of certainty over Brexit and enough operational expertise to really understand in what way were we dependent on membership to the EU” - Global Operations & Change Director (MNE3a) 2nd October 2018.

The task forces at MNE1 and MNE3 adopted a similar approach to strategy formulation; using worst-case assumptions during the planning process. According to interviewees, the worst-case outcome of Brexit was to leave the EU without a deal and for cross-border trade to revert to the World Trade Organization (WTO) terms. By trading under WTO terms, new tariff and non-tariff barriers would arise, new quality control checks would be required in the UK and the EU, and significant delays would occur at UK and EU ports of entry. The worst-case scenario planning approach is summarised by the Global Operations and Change Director at MNE3 as follows:

“We've taken a worst-case assumption. From day one we've assumed full WTO conditions; we've assumed a full failure of the import-export simplifications that are currently available in the EU. We've assumed full customs and regulatory frictions on the way in, on the way through, and on the way out of the EU. We're setting ourselves up for the worst case, no implementation period... and that's been our consistent underpinning company position. No patient left behind. Plan for the worst, hope for the best” - Global Operations & Change Director (MNE3a) 2nd October 2018.

These findings were supported by an article in the *Economist* dated 28th November 2017, which states:

“Pharmaceutical firms on both sides of the English Channel warn that time is running out for the EU and Britain to reach an agreement that allows them to continue without significant issues after March 2019. Companies would need several years to adjust if such a deal were not made. Even agreement on a transition period, to smooth the first years after Brexit may come too late to be of use to an industry with long production timelines. Firms are thus already preparing for a worst-case-scenario outcome in which no deal is reached and Britain operates outside of the EU’s medicine regulations and customs union.” (The *Economist*, 2017).

The Head of Global Logistics and Warehousing at MNE1 explained that by formulating their strategy based on the worst-case assumptions, his company was able to accept that Brexit would happen, and treat the eventual disruption as an operational issue, instead of an impending risk. While the worst-case scenario planning required significant tangible (money, infrastructure) and intangible (time, information gathering) resources, it meant his company could reduce, and even eliminate, the perceptions of heightened supply chain uncertainty surrounding Brexit:

“We don't have uncertainty because of the assumptions that we've made. So, we have assumed World Trade Organisation and non-mutual recognition of quality standards. You're talking risk management, I'm seeing this now as issue management, so it's going to happen” - Head of Global Logistics and Warehousing (MNE1) 26th May 2017.

Initially, MNE2 focused on gathering knowledge about the external business environment, which we coded as a wait-and-see strategy. It did not adopt a reactive/proactive strategy until the medium term. The Supply Chain Director from MNE2 suggested that Brexit was not treated as a strategic priority from the outset because his company is not headquartered in the UK, and the UK is a relatively small global market. We found that, in the longer-term, all three MNEs gathered detailed data on the capacity of their warehouses and distribution facilities, ports of entry, lead times, and quantities of buffer stock. At the same time, the MNEs voiced their concerns to pharmaceutical trade associations, supplying them with relevant supply chain data to influence the negotiating position of UK policy makers. The Supply Chain Director at MNE2 explained the information gathering and dissemination process as follows:

“We will spend most of the next year [2019] involved in lobby groups and various government and industry committees, trying to shape what Brexit looked like for the industry. What we have seen from the government is that they are trying to collect hard data around the impact of an absolute hard Brexit, and how ready is UK Plc. So, we've had to submit a lot of data around inventory levels, physical location of inventory, you know, and import plans post-March next year” - Supply Chain Director EMEA (MNE2a) 4th October 2018.

Having gathered sufficient information and made their planning assumptions, the MNEs then began to implement their respective strategies. In the medium-term, all three MNEs exhibited elements of a reactive approach; accumulating and redeploying variable assets throughout the supply chain. For example, all three MNEs accumulated surplus inventory in accordance with their overarching Brexit strategy and to comply with demands from the UK government to hold a minimum of six weeks stock of all manufactured products:

“We've now been asked specifically to carry an extra six weeks' inventory of every product. We've gone back and negotiated on that because some of our products we actually had six months inventory anyway, so we've had a more intelligent discussion and the Department of Health have endorsed our plans on that” - Supply Chain Director EMEA (MNE2a) 4th October 2018.

At the same time, all of the MNEs exhibited evidence of deploying tangible resources proactively. For example MNE1 invested in a new UK warehouse for the storage and distribution of pharmaceutical products for UK customers:

“From the end of this year [2018] we are going to have a warehouse setup in the UK within which we are going to store the product for UK patients. The French warehouse is going to lose the UK inventory, but what we're going to do in France is we're going to have to do sampling of product that is made in the UK and is destined for the EU 27” - Head of Global Logistics and Warehousing (MNE1) 5th October 2018.

MNE2 and MNE3 also exhibited elements of a proactive strategy in the medium term. For example, MNE3 purchased a new customs bonded facility in the UK to hold and clear medicines imported from the EU:

“What we've also done is procured importation clearance capacity in the UK - a bonded facility where you would hold medicine and clear it when it arrives. That importation clearance capacity is pretty limited, so that was one of our earlier securities that we needed to bag the available capacity while it was there” - Global Operations & Change Director (MNE3a) 2nd October 2018.

MNE2 proactively established a new Quality Processing Hub and a new Qualified Person (QP) in Ireland to handle all of the quality approvals and releases for medicines sold within the EU 27 countries.

4.2 The strategy formulation and implementation process for Large Companies

The primary difference between the MNEs and large companies in our study was found in the strategy formulation process. Specifically, large companies did not immediately form task forces, nor did they follow a worst-case scenario planning approach. In the longer term, large companies followed a wait-and-see strategy only, gathering information by building relationships with regulatory bodies and working with trade associations, as explained by the CEO of Supply Chain Operations at LRG2:

“We have, from the beginning, worked very closely with MHRA [Medicines and Healthcare products Regulatory Agency], which is the regulator on medical devices, medicines. And we are meeting very frequently with trade associations across the health system, and we're working very well together and the communications are open” - CEO of Supply Chain Operations (LRG2a) 14th March 2019.

The large companies spent significant intangible resources (management time) on gathering information from existing suppliers to determine their ability to provide continuity of supply, and any expected changes to pricing structures.

“Two weeks ago, organised by one of our 3PLs [third party logistics companies], we had a logistics board where the heads of logistics from the different companies come together with their experts. And there, we had a specific section purely on Brexit...at a really detailed level” - Supply Chain Director (LRG1a) 26th October 2018.

These quotes show that the strategy formulation process for large companies was based primarily on knowledge gathering exercises. Large firms waited until they had sufficient information before investing in any tangible resources. An interview with the supply chain director at LRG1 on 26th October 2018 revealed that his company implemented a reactive strategy alongside their wait-and-see strategy as the original Brexit date (29th March 2019) was fast approaching:

“We have positioned buffer stocks... we also made sure we have capacity to make products... and ensured that we have supply close by so we can react very quickly. So it's not just a wait-and-see approach anymore” - Supply Chain Director (LRG1a) 26th October 2018.

Similarly LRG2 also embarked on a reactive strategy alongside the wait-and-see approach, while LRG3 followed a wait-and-see strategy in the medium and a reactive strategy in the short-term, as evidenced by an interview with the Director of Supply Chain and Procurement at LRG3:

“So in supply chain, we decided to put a plan in place to stockpile finished product that we purchase from within the European Union. So we decided to take action on the finished product because we thought that that might be a bigger risk in terms of regulatory and customs issues” - Director of Supply Chain and Procurement (LRG3) 25th January 2019.

The delayed reactive strategy by LRG3 and the absence of any proactive strategy could be explained by its size being very close to the threshold for the SME category. The other large companies, LRG1 and LRG2, followed a mix of reactive and proactive strategies through the medium- and short-term. For example, LRG2 built buffer stock and added extra capacity to its transportation network (reactive), whilst building new warehouses to store the buffer stock (proactive). Similarly, LRG1 increased its inventory buffers and worked with third party logistics providers to secure more vehicle space (reactive), while simultaneously identifying new sources of supply in the EU for European customers (proactive). During the strategy implementation phase, the large companies in our study continued to gather knowledge on the risks posed by Brexit using a wait-and-see approach, while simultaneously investing in tangible resources as part of a reactive and proactive approach. These findings indicate that, in the medium- to short-term, large firms do not follow a distinct strategy but a mix of wait-and-see, reactive and proactive strategies.

4.3 The strategy formulation and implementation process for SMEs

The SMEs in our study followed either a passive or a wait-and-see strategy in the longer term due to resource constraints. The Operations Director at SME1 explained how her company was undertaking knowledge-gathering exercises with suppliers:

“We needed to find out more about what our suppliers were doing to mitigate Brexit. So we've done questionnaires to them... Some have come back saying they're looking in to it, others haven't come back at all, so we're just really in the process of chasing those all up” - Operations Director (SME1) 27th September 2017.

She explained that her team was contacting local business councils, Members of Parliament, and pharmaceutical trade associations for more information on Brexit:

“We’ve been lobbying through the Council who've got representatives, and I've written to our local MP. There's the [Pharma Trade Association] who we don't belong to, but they've been putting statements out into the press... so we're keeping abreast of various organisations and their campaigns” - Operations Director (SME1) 27th September 2017.

During the second interview with SME1 (9th October 2018), the Operations Director explained that her company had started to make tangible resource commitments by building buffer inventory (reactive) and expanding its European production facility (proactive) to sell directly to European customers. The interview findings suggest that the implementation of both reactive and proactive strategies at SME1, in addition to the existing wait-and-see approach, was prompted by shortening time horizons in the lead up to the initial Brexit leaving date (31st March 2019). SME1 has 450 employees, putting it on the cusp of the “large” categorisation of firms; this likely explains why it followed a strategy formulation and dissemination process similar to those followed by large firms in our study.

SME2, which is considerably smaller than SME1 with 150 employees and much lower revenue, followed a passive strategy in the long term whilst transitioning into a wait-and-see strategy in the medium to short term - gathering information but not making any tangible resource commitments. During an interview with the CEO from SME2 on 4th October 2017, she explained that: “*As far as I see it we don't have any strategy....I don't think there is very much change in business model or in sales strategies*”. During a follow-up interview a year later (5th October 2018), she explained how her company moved to a wait-and-see strategy prompted by pharmaceutical trade associations asking their members to be prepared for Brexit.

“It was in the summer actually... That's when this news came around and all these industry networks started to bring out press releases and talk about this [Brexit], and asked their member companies 'please come on, get prepared'” - CEO (SME2) 5th October 2018.

She went on to explain that while her company was actively gathering information, they were not going to make any tangible investments in new facilities, equipment or stock until the exact nature of the Brexit divorce bill was clarified. An excerpt from the *Economist* of 2nd February 2019 explains the predicament in which SMEs found themselves:

“No-deal planning is expensive, and many of Britain’s 5.7m small and medium companies are loath to invest in something that may never happen. In a recent poll by the Institute of Directors, which mainly represents smaller firms, 40% said they

would not do anything until “the new relationship between the UK and the EU is completely clear.” (The *Economist*, 2019b).

SME2 fits nicely into the *Economist*’s description, as it is heavily resource constrained and unable to make investments until the exact nature of the UK-EU trading partnership was known. However, we did not find evidence of companies following a passive, do-nothing approach over the medium and short term. Instead, all companies conducted some form of knowledge gathering activity and did not sit idly by waiting for the event to materialise. We now discuss these findings in relation to the existing literature to arrive at a framework for managing supply chain uncertainty and risk arising from geopolitical disruptions.

5. Discussion

Returning to Milliken’s (1987) definition of uncertainty, we suggest that supply chain uncertainty is a matter of perception, and such perceptions can be changed during the strategy formulation process. All of the firms in our study, except the smallest (SME2), followed a wait-and-see strategy in the longer term; collecting information from supply chain partners and disseminating this information to policy makers. We therefore class wait-and-see as a preliminary strategy used to gather information and reduce perceived levels of heightened supply chain uncertainty. Once supply chain uncertainty was perceived to be at tolerable levels, the managers in our study implemented reactive and/or proactive strategies to manage supply chain risks. Here we find support for the assertion of Knight (1921) and March and Shapira (1987) that risk is a consequence of uncertainty and not a substitute for it. Our findings indicate that deploying intangible resources to reduce perceptions of heightened supply chain uncertainty and deploying tangible resources to mitigate supply chain risks are two important conditions when attempting to achieve strategic fit with the external business environment. This leads us to propose the following:

Proposition 1: Perceptions of heightened supply chain uncertainty can be reduced to tolerable levels during the strategy formulation process by deploying intangible resources to gather and disseminate supply chain knowledge.

Proposition 2: Perceptions of heightened supply chain uncertainty need to be reduced to tolerable levels before a firm will invest in tangible resources to mitigate supply chain risks.

Our findings reinforce the assertion of Zajac et al. (2000) that achieving strategic fit with the external business environment is an organisationally and temporally unique process, rather than being common across many organisations in a given context. The contingency variables examined in our study, strategic context and firm size, shed some light on the different approaches for achieving strategic fit. The strategic context examined in our study (Brexit) changed over time as politicians repeatedly attempted to reach a deal over the terms of the EU exit bill. However, while the nature of the strategic context changed, it was fundamentally the same strategic context faced by all firms in our study. It was the contingency variable of firm size, and correlated levels of resource slack, that affected the strategies for fit used by our case companies when faced with the same strategic context. A key difference between the MNEs and the relatively more resource constrained large firms and SMEs in our study, was that the MNE1 and MNE3 used their slack resources (money and management time) to form task forces and develop a series of worst-case planning assumptions. These findings support Cyert and March's (2013) assertion that resource slack provides discretionary resources for managers in the face of unexpected environmental shifts and the resulting uncertainty that this creates.

By using worst-case assumptions during the strategy formulation process, MNE1 and MNE3 were able to reduce perceived levels of uncertainty surrounding Brexit within their respective organisations. The Supply Chain Director at MNE1 explained that *"Due to our worst-case approach, Brexit is no longer a risk to us...we are treating it as an issue that needs to be managed like all of the other day-to-day issues that we encounter"*. Specifically, embedding worst case assumptions in the strategy formulation process focused management efforts on preparing for the worst possible outcome, with any other outcome providing benefits to the organisation. This leads us to propose that:

Proposition 3: Perceptions of heightened supply chain uncertainty can be reduced to tolerable levels by embedding worst case scenario planning assumptions in the strategy formulation process

The SCRM literature primarily focuses on the strategy implementation phase, or how companies deploy tangible resources to mitigate supply chain risks (Ambulkar et al., 2015; Craighead et al., 2007). An implicit assumption of much of the SCRM literature is that companies will follow a distinct type of strategy (passive, reactive, proactive) when attempting to manage supply chain disruptions (Chopra and Sodhi, 2004; Grotsch et al., 2013; Simangunsong et al., 2012). For example, Thun et al. (2011) found that SMEs

managed supply chain risks by building up redundancies (safety stock, overcapacity) to reduce the severity of the risk event (a reactive approach), while large companies attempted to reduce the possibility that the disruptive event would occur (a proactive strategy). Ellegaard (2008) found that small companies followed a passive approach as they avoided negotiating multi-sourcing contracts and did not build redundancies because of resource constraints.

Our study revealed a more nuanced approach by firms, where companies often blurred the lines between wait-and-see, reactive, and proactive strategies; deploying multiple strategies concurrently. For example, the smallest company in our study (SME2) followed a passive strategy in the long term, and then moved to a wait-and-see strategy in the medium and short term. This finding is in contrast with Ellegaard (2008), who suggested that small firms would not gather market intelligence or build new supplier relationships. We found that a passive strategy can transition into a wait-and-see strategy. Also, we found a wait-and-see strategy can co-exist with reactive and proactive strategies without any definitive transition being made. Indeed, all of the companies in our study followed more than one strategy for managing supply chain risks and these strategies changed over time. This leads to our fourth proposition:

Proposition 4: Supply chain risk management strategies will often co-exist and will change over time as perceptions of supply chain uncertainty reduce to tolerable levels.

Drawing together these propositions, we now advance an empirically informed model of strategies for managing the supply chain uncertainty that arises from geopolitical events (see Figure 2).

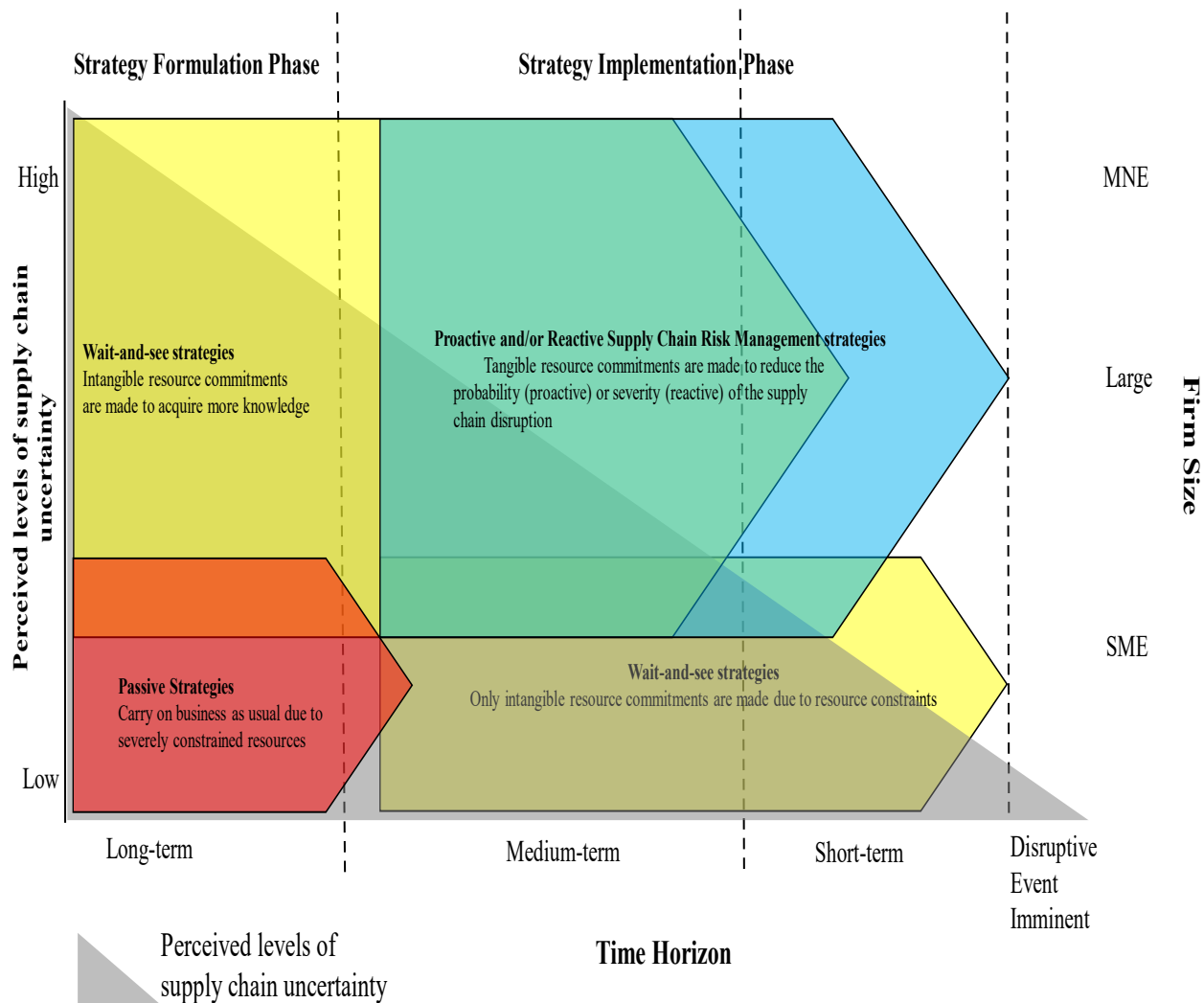


Figure 2: Empirically informed framework: strategies for managing supply chain uncertainty and supply chain risk for companies of different sizes

6. Contribution, limitations and areas for future research

6.1 Theoretical contribution

This study contributes to strategic contingency theory by exploring the interaction between the contingency variables of firm size and strategic context. By conducting a longitudinal study of the Brexit phenomenon, we gathered evidence to show that as a strategic context changes, a firm's strategy to achieve fit with the external business environment will also change, but not necessarily at the same time nor in the same manner. The study elaborates on strategic contingency theory by identifying two conditions needed to achieve strategic fit with an external environment disrupted by a geopolitical event: first, deploying intangible resources (management time, knowledge gathering activities) to reduce perceptions of heightened supply chain uncertainty and, second, deploying tangible resources (supply

chain redundancies, new supply chain assets) to mitigate the negative outcomes of supply chain risks.

By using worst-case assumptions during the strategy formulation process, the MNEs in our study reduced perceived levels of heightened supply chain uncertainty surrounding Brexit. Once supply chain uncertainty was perceived to be tolerable, the MNE and large firms in our study deployed tangible resources using reactive and proactive strategies to reduce the severity of supply chain risks. The smallest company in our study (SME2) exhibited evidence of a strategic misfit in the longer to medium term when the geopolitical landscape changed and they did not, or could not, change in response due to resource constraints.

Our findings contribute to the literature by building the argument that supply chain uncertainty antecedes supply chain risk. We challenge an implicit assumption that firms will adopt either a passive, reactive, or proactive strategy and follow this strategy through to completion (Grotsch et al., 2013; Knemeyer et al., 2009). Our findings suggest that strategies for managing supply chain uncertainty, and subsequently supply chain risk, often co-exist and change over time as the nature of the external business environment alters. This contribution builds on important theoretical work underway in the OM literature about the application of contingency theory in a supply chain context (Cousins et al., 2019; Flynn et al., 2016; Walker et al., 2015).

6.2 Managerial Contribution

Managers are provided with a framework for managing the supply chain uncertainty and subsequent risks that arise from geopolitical disruptions. SCRM scholars have examined how companies manage supply chain risks arising from natural disasters (Elluru et al., 2017), terrorist attacks (Knemeyer et al., 2009), supplier insolvencies (Thun and Hoenig, 2011), and financial crises (Blome and Schoenherr, 2011). However, they have paid much less attention to the disruptive nature of geopolitical events. This is a noteworthy omission because geopolitical events, such as elections and regime changes, often impact multiple aspects of the supply chain (Hendry et al., 2019). Political disputes can restrict access to personnel and, in extreme cases, shut down transportation and distribution networks, such as the protests that brought Hong Kong to a halt in 2019 (*The Economist*, 2019a). Trade disputes, such as the one between the USA and China in 2018/19, can dramatically increase the price of raw materials (i.e., steel and aluminium) and influence the competitiveness of firms in home markets (*Financial Times*, 2019).

The SCRM literature calls on supply chain managers to act proactively by investing in risk detection and market intelligence programmes, or reactively by investing in excess stock, dual suppliers, and redundant supply chain infrastructure (Chopra and Sodhi, 2004; Jüttner et al., 2003; Thun et al., 2011). We suggest that managers may also want to consider a wait-and-see strategy in the first instance to reduce perceptions of heightened supply chain uncertainty before making costly and difficult to reverse tangible resource commitments.

6.3 Limitations and Future Research Directions

The findings from this study should be viewed in light of its limitations. Rather than statistical generalisation, we aimed for the theoretical generalisation of our findings (Yin, 2014). Our findings informed four propositions and an empirical framework, which elaborated on strategic contingency theory. We call on future researchers to use other research methodologies, such as surveys or questionnaires, to test our propositions. Further, our study is limited to an examination of the pharmaceutical industry, which has unique characteristics including a direct impact on human life, as well as strong regulatory oversight. As pharmaceutical companies are dealing with lifesaving medications, they are required to hold certain levels of inventory and have accredited processes (Good Manufacturing Practices), whereas other industries may not have the same compliance issues. Compliance with regulatory regimes means that pharmaceutical companies may take significant time to implement new strategies for managing supply chain risks. We encourage future researchers to examine the validity of our propositions in other industries, such as aerospace or automotive, which have different regulatory regimes and stakeholders.

Furthermore, our paper examined a geopolitical event (Brexit) that has a unique set of properties and affects companies in distinct ways. Future researchers could examine other geopolitical events that have a defined set of outcomes (i.e., elections), versus those that are unplanned and have an undefinable set of outcomes (i.e., war, terrorism, riots). By examining our propositions in the context of geopolitical events with unknowable outcomes, future research can identify the strategies that firms use when attempting to manage pure uncertainty. Finally, we suggest a potentially fruitful area of future research is an examination of how companies of various sizes create resource slack, be it tangible or intangible resources, and then deploy slack resources to achieve fit with the external environment

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